

JCO7 Rec'd PCT/PTO 13 MAR 2000

FORM PTO-1300 (REV. 11-2000)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER	
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371				3787-0112P	
				U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	
INTERNATIONAL APPLICATION NO.		INTERNATIONAL FILING DATE		PRIORITY DATE CLAIMED	
PCT/SE00/01755		September 11, 2000		September 13, 1999	
TITLE OF INVENTION A METHOD FOR THE MANUFACTURING OF A MATRIX AND A MATRIX MANUFACTURED ACCORDING TO SAID METHOD					
APPLICANT(S) FOR DO/EO/US OHMAN, Ove and LARSSON, Olov					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:					
<p>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39 (1).</p> <p>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))</p> <p>    <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau). WO 01/19586</p> <p>    <input checked="" type="checkbox"/> has been transmitted by the International Bureau.</p> <p>    <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</p> <p>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <p>    <input type="checkbox"/> is transmitted herewith.</p> <p>    <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4)</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>    <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).</p> <p>    <input type="checkbox"/> have been transmitted by the International Bureau.</p> <p>    <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p>    <input checked="" type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p>					
Items 11. to 20. below concern document(s) or information included:					
<p>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98, Form PTO-1449(s), and International Search Report (PCT/ISA/210) with 5 cited document(s).</p> <p>12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input checked="" type="checkbox"/> A FIRST preliminary amendment.</p> <p>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821-1.825.</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</p> <p>20. <input type="checkbox"/> Other items or information:</p> <p>    <input checked="" type="checkbox"/> 1. PCT/IPEA/409</p> <p>    <input checked="" type="checkbox"/> 2. Three (3) Sheets of Formal Drawings</p>					

JC10 Rec'd PCT/PTO 13 MAR 2002

U.S. APPLICATION NO (if known, see 37 CFR 1.53) <b>10/070912</b>		INTERNATIONAL APPLICATION NO PCT/SE00/01755		ATTORNEY'S DOCKET NUMBER 3787-0112P	
---	--	--	--	--	--

21. <input checked="" type="checkbox"/> The following fees are submitted. <b>BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5):</b> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO. .... <b>\$1,040.00</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO. .... <b>\$890.00</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO. .... <b>\$740.00</b>  International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4). .... <b>\$710.00</b>  International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4). .... <b>\$100.00</b> <b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b> Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)). <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th style="width:20%;">CLAIMS</th> <th style="width:20%;">NUMBER FILED</th> <th style="width:20%;">NUMBER EXTRA</th> <th style="width:20%;">RATE</th> <th style="width:20%;"></th> </tr> <tr> <td>Total Claims</td> <td>38 - 20 =</td> <td>18</td> <td>X \$18.00</td> <td>\$ 324.00</td> </tr> <tr> <td>Independent Claims</td> <td>2 - 3 =</td> <td>0</td> <td>X \$84.00</td> <td>\$ 0</td> </tr> <tr> <td colspan="4">MULTIPLE DEPENDENT CLAIM(S) (if applicable) Yes</td> <td>+ \$280.00 \$ 280.00</td> </tr> <tr> <td colspan="4" style="text-align: right;"><b>TOTAL OF ABOVE CALCULATIONS =</b></td> <td><b>\$ 1644.00</b></td> </tr> </table> <input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2. \$ 0 <div style="text-align: right;"><b>SUBTOTAL = \$ 1644.00</b></div> Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)). \$ 0 <div style="text-align: right;"><b>TOTAL NATIONAL FEE = \$ 1644.00</b></div> Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property + \$ 40.00 <div style="text-align: right;"><b>TOTAL FEES ENCLOSED = \$ 1684.00</b></div> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:70%;"></td> <td style="width:30%;">Amount to be: \$</td> </tr> <tr> <td></td> <td>refunded</td> </tr> <tr> <td></td> <td>charged \$</td> </tr> </table>	CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		Total Claims	38 - 20 =	18	X \$18.00	\$ 324.00	Independent Claims	2 - 3 =	0	X \$84.00	\$ 0	MULTIPLE DEPENDENT CLAIM(S) (if applicable) Yes				+ \$280.00 \$ 280.00	<b>TOTAL OF ABOVE CALCULATIONS =</b>				<b>\$ 1644.00</b>		Amount to be: \$		refunded		charged \$	<b>CALCULATIONS PTO USE ONLY</b>
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE																													
Total Claims	38 - 20 =	18	X \$18.00	\$ 324.00																												
Independent Claims	2 - 3 =	0	X \$84.00	\$ 0																												
MULTIPLE DEPENDENT CLAIM(S) (if applicable) Yes				+ \$280.00 \$ 280.00																												
<b>TOTAL OF ABOVE CALCULATIONS =</b>				<b>\$ 1644.00</b>																												
	Amount to be: \$																															
	refunded																															
	charged \$																															

a) ☒ A check in the amount of \$ **1684.00** to cover the above fees is enclosed.

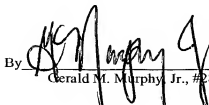
b) ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_ to cover the above fees.  
 A duplicate copy of this sheet is enclosed.

c) ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-2448.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

Send all correspondence to:  
**Birch, Stewart, Kolasch & Birch, LLP or Customer No. 2292**  
**P.O. Box 747**  
**Falls Church, VA 22040-0747**  
**(703) 205-8000**

Date: March 13, 2002

By  Gerald M. Murphy Jr., #28,977

10070912.031302

10/070912

JC10 Rec'd PCT/PTO 13 MAR 2002

PATENT  
3787-0112P

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant: OHMAN, Ove et al.  
Int'l. Appl. No.: PCT/SE00/01755  
Appl. No.: NEW Group:  
Filed: March 13, 2002 Examiner:  
For: A METHOD FOR THE MANUFACTURING OF A  
MATRIX AND A MATRIX MANUFACTURED  
ACCORDING TO SAID METHOD

PRELIMINARY AMENDMENT

**BOX PATENT APPLICATION**

Assistant Commissioner for Patents  
Washington, DC 20231

March 13, 2002

Sir:

The following Preliminary Amendments and Remarks are respectfully submitted in connection with the above-identified application.

AMENDMENTS

IN THE SPECIFICATION:

Please amend the specification as follows:

Before line 1, insert --This application is the national phase under 35 U.S.C. § 371 of PCT International Application No. PCT/SE00/01755 which has an International filing date of September 11, 2000, which designated the United States of America.--

Docket No. 3787-0112P

In the Claims:

Please amend the claims as follows:

11. (Amended) A method as claimed in claim 1 or claim 10, characterized in that the plastic composite is selected from a mixture of a polymer material and a filler material, such as quartz or metal-filled epoxy or silicon polymer.

14. (Amended) A method as claimed in claim 1, characterized in that the plastic composite is selected from two-component types.

17. (Amended) A method as claimed in claim 1 or claim 10, characterized in that said first wear layer and/or said second wear layer consist of titanium nitride or DLC (Diamond-Like-Carbon).

19. (Amended) A method as claimed in claim 1 or claim 10, characterized in that the first wear layer and/or metal layer is selected having a thickness adapted to stipulated requirements.

Docket No. 3787-0112P

REMARKS

The specification has been amended to provide a cross-reference to the previously filed International Application.

The claims have been amended to remove improper multiple dependencies and to place the application into better form for examination.


Entry of the above amendments is earnestly solicited. An early and favorable first action on the merits is earnestly solicited.

Attached hereto is a marked-up version of the changes made to the application by this Amendment.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By   
Gerald M. Murphy, Jr., #28,977

GMM/sll  
3787-0112P

P.O. Box 747  
Falls Church, VA 22040-0747  
(703) 205-8000

Attachment: VERSION WITH MARKINGS TO SHOW CHANGES MADE

(Rev. 02/21/02)

Docket No. 3787-0112P

VERSION WITH MARKINGS TO SHOW CHANGES MADEIN THE CLAIMS:

The claims have been amended as follows:

11. (Amended) A method as claimed in claim 1 [and]or claim 10, characterized in that the plastic composite is selected from a mixture of a polymer material and a filler material, such as quartz or metal-filled epoxy or silicon polymer.

14. (Amended) A method as claimed in claim 1 [or claim 11], characterized in that the plastic composite is selected form two-component types.

17. (Amended) A method as claimed in [claim 1, claim 10 or claim 16]claim 1 or claim 10, characterized in that said first wear layer and/or said second wear layer consist of titanium nitride of DLC (Diamond-Like-Carbon).

19. (Amended) A method as claimed in [claim 1, claim 10 or claim 18]claim 1 or claim 10, characterized in that the first wear layer and/or metal layer is selected having a thickness adapted to stipulated requirements.

## A METHOD FOR THE MANUFACTURING OF A MATRIX AND A MATRIX MANUFACTURED ACCORDING TO SAID METHOD

### *Technical field*

5       The present invention relates in the first place to a method for the manu-  
facture of a matrix suitable for use as a mould-cavity insert in a compression-  
moulding, embossing and/or injection-moulding machine, and particularly to a  
matrix having one surface, or a part thereof, provided with a microstructure, which  
10       microstructure is reproducible on the surface of a plastic component as a com-  
plementary microstructure in a machine used, said component being formed of a  
plastic composite or plastic material used.

      The invention relates in the second place to a matrix manufactured in ac-  
cordance with the method, which is suitable for use in a compression-moulding,  
embossing and/or injection-moulding machine.

15       Matrices of the type under discussion can be manufactured by having a  
master or an original, with a (positive) microstructure on its surface coated with a  
number of layers of metal, removing the metal layers, with a (negative) micro-  
structure, from the master, which thus forms a metal plate serving as a matrix or  
mould-cavity insert in the compression-moulding, embossing and/or injection-  
20       moulding machine.

      The expression "positive" surface structure shall be understood to mean  
the surface structure that appears on a plastic component produced from the  
plastic material in a machine, and "negative" surface structure shall be understood  
to mean its inverse surface structure, i.e. the surface structure displayed by a ma-  
25       trix or mould-cavity insert in the machine used.

      "Plastic composite" shall be taken to mean a mixture of a polymer material  
and a curable filler material, where the filler material is usually in excess.

      The method associated with the present invention shall be deemed appli-  
cable for directly producing a matrix or mould-cavity insert for a machine for  
30       moulding plastic components, which may then be considered as an original, an  
original from which another matrix, an original, can be produced, from which a  
replicated original can be manufactured, etc.

      A person skilled in this technical area will perceive that a method for ma-  
nufacturing a matrix serving as a mould-cavity insert could very well be used for  
35       manufacturing an original, from which said matrix is formed, a superior original  
from which said original can be formed, and so on.

### **Background art**

When replicating microstructures on plastic components manufactured in a machine of the type described in the introduction, it is known and usual to first manufacture an original or master in a suitable manner, and from this master manufacture a matrix in the form of a mould-cavity insert for the machine.

A known method of manufacturing such a master entails the use of known lithographic methods.

It is in this case advantageous to select lithographic methods that have been developed primarily for use in the micro-electric field.

One of these methods is based on performing etching and/or depositions on the surface of a semiconducting material.

Other methods are based on removing parts of the material with the aid of a laser, so-called laser ablation, using conventional NC machines, with the aid of a precision-controlled diamond cutter with high-speed spindle, with the aid of wire or electro-erosion and/or some other suitable method.

Such originals or masters are usually manufactured in a material suitable for the selected treating method.

In the case of lithographic processes, therefore, the material is usually a plate or a sheet of silicon, glass or quartz, whereas for laser ablation, the material selected is usually a plate or a sheet of a plastic composite and/or a polymer.

For material machining both plastic and relatively soft metals may be suitable.

It is well known that the demands placed on a selected replication process for a certain choice of material in the matrix or mould-cavity insert and the plastic component are not the same as those that must be placed on the original or the master.

It may thus be mentioned that when injection-moulding plastic components in a machine, in which one or more surface parts shall display a micro-structure, mould halves pertaining to the machine and matrices or mould-cavity inserts used for one or both mould halves must be made of a stable material that will withstand the high pressures prevailing during the manufacturing process, and that will not be worn down unnecessarily quickly by the thermal and mechanical wear the mould parts and matrix are subjected to during the moulding process.

It is known to manufacture such matrices, particularly matrices used in microsystem context, by having the shape and surface structure of a master transfer to a metal sheet formed as a matrix.

Such manufacture is based on first manufacturing a master on the surface of a plate or sheet of glass, a semi-conducting material or metal, coating the surface with a light-sensitive layer and, via laser or the like, exposing selected sur-



face sections of this light-sensitive layer, and then washing and cleaning these selected surface sections.

A metal layer is then applied on this exposed and cleaned surface by means of a sputtering process and/or a vaporising process and, if necessary, a plating process for a sufficient length of time for a metal sheet to be formed.

When the metal sheet is removed from the master it can display a first surface with a negative microstructure and can serve as a matrix or a mould-cavity insert, after additional machining, a plaining machining, of a second surface facing the mould half in the machine.

This is the method that is currently used for manufacturing a matrix or mould-cavity insert for inclusion in an injection moulding machine, intended for the manufacture of optical plates or discs.

It is known to coat an electrically insulating plate or disc serving as master or matrix and having a microstructure, with a thin layer of metal by means of a sputtering and/or vaporising process.

It is known to coat an electrically insulating plate or disc or layer serving as matrix and having a microstructure, with a considerably thicker layer of metal by means of a plating process.

It is known via a plating process to coat a disc intended as matrix, with an electrically conducting layer such as nickel, silver, gold or the like.

It is also usual to have an applied metal layer contacted and a disc immersed in a solution consisting of, amongst other things, metal ions, whereupon a current is forced through the solution towards the disc and metal ions are precipitated out as a pure metal on the surface. It is thus possible to produce a structure in the metal that has a function inverse to the microstructure on the master.

It has been found that the method described above is simple to use for relatively flat structures, particularly when the depth of the microstructure is limited to and chosen less than approximately 0.2  $\mu\text{m}$ .

In conclusion, it can be ascertained that different methods can be used to produce originals with different microstructures.

It is thus known, during working of one and the same material (silicon plate or disc) to create, in several processes, different micro and surface structures on different surface sections, to be transferred to a matrix.

The time it takes to manufacture an original is substantially the sum of the times required for each process used.

In the following description, thus, a first method is mentioned for manufacturing an original with a first type of microstructure, a second method for manufacturing an original with a second type of microstructure, and so on, in

which a first matrix manufactured via the first original and a second matrix manufactured via the second original will be used.

### ***Description of the present invention***

#### **Technical problems**

Considering that the technical deliberations a person skilled in the art must perform in order to be able to offer a solution to one or more of the technical problems posed constitute initially an insight into the measures and/or the sequence of measures to be taken, and also a selection of the means required, the following technical problems should be relevant in developing the object of the present invention.

Considering the prior state of the art as described above, it would appear to be a technical problem to be able to propose a simple method for manufacturing a matrix adaptable for use in a compression-moulding, embossing and/or injection-moulding machine in which the matrix is provided with a negative microstructure on its surface and which microstructure is reproduced in the machine as a positive microstructure on a surface part of a plastic component produced via a utilised plastic composite or plastic material, thereby creating an inexpensive matrix with a sharp microstructure where the matrix may serve as mould-cavity insert and may display a microstructure section of a first type, or a second type, etc., like a hybrid.

It should also be considered a technical problem, with the aid of a number of originals, manufactured in accordance with individual manufacturing processes, and/or a number of matrices produced from these originals, to create such conditions that the time required for producing a mould-cavity insert can be substantially reduced, despite complex surface sections for said insert.

A technical problem is also entailed in being able, using simple means, to create such conditions that said mould-cavity insert can be assigned a microstructure-related first wear surface formed on a first layer, with an adaptable and relatively high wear resistance.

It is also a technical problem to be able, using simple means and measures, to create conditions enabling a matrix to be built up of at least two layers, a thin first wear layer displaying said microstructure-related surface, and a thicker layer reinforcing this thin layer, the thicker layer being termed "carrier" in the following.

It should also be deemed a technical problem to be able to advocate a method for manufacturing a matrix in which a first master, with a first chosen microstructure, can be produced via a first process and a second master, with a second chosen microstructure, can be manufactured via a second process, sepa-

rate from the first, and in which the whole or selected parts of matrices manufactured from said first and second masters are combined to form said matrix.

It is also a technical problem to be able to perceive the significance of and the advantages associated with manufacturing said first master with a number of similar or dissimilar surface sections, each of these, transferred to a matrix, being removable to form a first matrix section.

It is also a technical problem to be able to perceive the significance of and the advantages associated with manufacturing said second master with a number of similar or dissimilar surface sections, each of these, transferred to a matrix, being removable to form a second matrix section.

It is also a technical problem to be able to perceive the significance of and the advantages associated with one or more first matrix sections and one or more second matrix sections being applied with their microstructured surfaces on a support, where a sheet of nickel such as a flat sheet with polished surface, a mirror surface, is chosen as support.

A technical problem is entailed in being able to perceive the conditions for and advantages associated with said first matrix or a first matrix section, and said second matrix or a second matrix section, and/or one or more additional matrices or matrix sections, being pressed against the support at least while they are being covered by a first wear layer.

It is furthermore a technical problem to be able, using simple measures, to create such conditions that the material of a first, thin layer and the material of a second, thick layer or carrier can be selected having such properties and/or thicknesses that they can fulfil predetermined requirements and conditions for a mould-cavity insert.

It is also a technical problem to be able to perceive the significance of and the advantages associated with said matrix being manufacturable by a master with a microstructure assigned to its surface being coated with metal by means of a metal coating process, and coating the thin metal layer with a plastic composite to form said carrier.

It is also a technical problem to be able, using simple means and measures, to manufacture a matrix formed substantially or exclusively from a plastic composite, usable in a machine, where the time required for manufacture of the matrix from a master is considerably reduced, partly by being able to entirely  
35 eliminate, or at least considerably reduce, the time required for forming a flat reverse side of a matrix from the plastic composite, which rear side can abut tightly against one of the two mould halves in the machine.

It is also a technical problem to be able to perceive the significance of using a master for the manufacture of the matrix, and applying a thin layer of

metal to its positive microstructure surface, and for said metal layer, on the rear side of the microstructure, to display irregularities substantially corresponding to the microstructure, and to also perceive the advantages of filling said irregularities with a supporting plastic composite that, after curing or the like, forms a supporting carrier in the form of a layer, instead of building up the entire matrix with a thick metal layer.

It is also a technical problem to be able to perceive the significance of such filling of a chosen plastic composite and the formation of a carrier taking place in a special mould cavity.

It is also a technical problem to be able to perceive the significance of and the advantages associated with the plastic composite, and thus the carrier, being selected from a mixture of a plastic or polymer material and a filler material such as quartz or metal-filled epoxy or silicon polymer.

It is also a technical problem to be able to perceive the significance of and the advantages associated with the plastic composite used, and thus the carrier formed, being chosen with a coefficient of linear expansion and/or a heat transfer capability and/or a thermal capacitive capability suitable for a chosen process in the machine used.

A technical problem is also entailed in making use of a specifically chosen curing process in order to assign the chosen plastic composite a hardness and/or curing time dependent on the application by supplying heat to selected portions of the plastic composite or compound and/or illuminating the plastic composite or compound with UV light or, alternatively by the plastic composite being selected as a two-component type.

A technical problem is entailed in being able to perceive the significance of adapting a first wear layer and/or a thin metal layer and selecting the plastic composite, and thus the carrier, with a low heat transfer capability in order to keep the plastic compound pressed out into the machine and between the mould halves hot.

It is also a technical problem to be able to perceive the significance of and the advantages associated with, as well as the dimensioning rules required for, applying a second layer on the surface of the carrier facing away from the microstructured surface of the metal layer.

It is also a technical problem to be able to perceive the significance of selecting said second wear layer from a material displaying the properties of low friction against the flat surface of the mould half and high durability, such as titanium nitride or DLC (Diamond-Like-Carbon).

It is also a technical problem to be able to perceive the significance of said thin metal layer being applied on the master or original, if this consists of a

non-electrically conducting material, by means of a sputtering process and/or a vaporising process or, if this consists of an electrically conducting material or an applied thin metal layer, by means of a plating process.

- 5 A technical problem is also entailed in, depending on the application in question, selecting the thickness of the metal layer in the injection-moulding machine within predetermined limits.

- 10 A technical problem is also entailed in being able to perceive the significance of and the advantages associated with creating such conditions that plain-  
ing of the rear side of the matrix and the carrier is considerably simplified and/or  
entirely eliminated.

### Solution

- 15 To provide a solution to one or more of the technical problems listed above, the present invention is based on a method for the manufacture of a matrix, such as one provided with a (negative) microstructure on its surface, which microstructure is reproducible in a plastic composite or material as an inverted or complementary (positive) microstructure on a plastic component, in an injecting-moulding machine.

- 20 The invention is based on said matrix being manufactured by having a master or an original with a microstructure on its surface coated with a covering material.

- 25 The method in accordance with the invention relates particularly to a first master with a first chosen microstructure being produced via a first method, a second master with a second chosen microstructure being produced via a second method and, if necessary, one or more additional masters with chosen microstructures being produced via additional chosen methods.

It is also advocated that said first and second masters, or a matrix formed therefrom, be applied or placed with their microstructured surfaces adjacent.

- 30 Said first and second masters or matrices shall thereafter be covered with a layer pertaining to a first matrix, after which said layer is covered by a thicker layer, a carrier.

Said first and second first layers pertaining to the matrix, and said carrier, are now removed from said masters as a matrix-related unit.

- 35 Preferred embodiments falling within the scope of the present invention propose that said first master is produced having a number of similar or dissimilar surface sections, and that each of these, transferred to a matrix, is removed to form a first matrix section.

Said second master may also be produced having a number of similar or dissimilar surface sections, each of these, transferred to a matrix, is removed to form a second matrix section.

One or more first matrix sections and one or more second matrix sections and/or further additional matrix sections are applied with their microstructured surfaces on a support.

A sheet of nickel may advantageously be chosen as the support, said sheet usually consisting of a flat sheet with polished surface, like a mirror surface.

Said first matrix or a first matrix section, and said second matrix or a second matrix section, etc., are pressed against a support at least while they are being covered by a first wear layer.

The first matrix or matrix section has been provided with a first type of one amongst several selectable microstructures, the second matrix or matrix section has been provided with a second type of one amongst several selectable microstructures, and so on.

In accordance with proposed embodiments of the present invention pouring in a plastic composite, in order to smooth out irregularities, may be performed in a mould cavity.

It is also proposed that the plastic composite, and thus the carrier, may be selected from a polymer material and a filler material such as quartz or metal-filled epoxy or silicon polymer.

The plastic composite, and thus the carrier formed, may also be chosen with a coefficient of linear expansion and/or a heat transfer capability and/or a thermal capacitive capability suitable for a chosen process in and the design of the injection-moulding machine.

The plastic composite shall be cured in a manner suitable for injection moulding, such as by the supply of heat and/or illuminated by means of UV light.

The plastic composite could also be selected as a two-component type.

In accordance with the present invention a plastic composite, and thus the carrier, located under a hard wear layer serving as wear surface, shall be selected with a suitable heat transfer and/or thermal capacitive capability for keeping the plastic compound in the machine hot, while at the same time achieving short cycle times.

Also in accordance with the invention said plastic composite, and thus the carrier, may be coated with a second wear layer on the surface facing away from the surface of the first wear layer, in order to reinforce the matrix construction against damage due to wear.

Said second wear layer could consist, for instance, of titanium nitride or DLC.

In accordance with the invention said thin first wear layer may very well consist of a metal layer and this metal layer shall be applied by means of a sputtering process and/or a vaporising process or, alternatively, a plating process.

5 In accordance with the invention the thickness of the first wear layer, such as the metal layer, shall be selected with care, depending on the application and the design of the injection-moulding machine.

The invention also relates to a matrix suitable for use in a compression-moulding, embossing and/or injection-moulding machine as described above.

#### 10 Advantages

The advantages that may be primarily considered characteristic of a method for manufacturing a matrix in accordance with the present invention for a compression-moulding and/or injection-moulding machine are thus that conditions are thereby created for achieving simple manufacture of the matrix by manufacturing a first master via a first process, a second master via a second process and, if necessary, producing matrices from these masters and thereafter combining said matrices or parts thereof to a matrix which is therefore simpler to produce with extremely varied microstructure-related sections, deriving from different manufacturing methods for the originals or masters used.

20 Adaptation of heat transfer and/or thermal capability of the matrix is thus possible so that the replication ability is increased in the manufacturing process, such as the embossing and/or injection-moulding process, since the plastic material being moulded does not freeze as soon as it comes into contact with the microstructured surface of the matrix but retains its fluidity properties sufficiently long for the microstructure pertaining to the matrix to be efficiently replicated on the plastic component produced.

25 The features deemed to be primarily characteristic of a method in accordance with the present invention are defined in the characterising part of the appended claim 1, and the features deemed most characteristic for a matrix in accordance with the present invention are defined in the characterising part of the appended claim 21.

#### ***Brief description of the drawings***

35 A currently preferred embodiment of an injection-moulding machine in which a matrix significant for the invention could be used, and a method for manufacturing this matrix, as well as a matrix thus manufactured with the features significant for the invention, will now be described in more detail with reference to the accompanying drawings, in which

- Figure 1 shows schematically a side view of an injection-moulding machine, utilising two mould halves assuming a position co-operating with each other,
- 5 Figure 2 shows the machine illustrated in Figure 1, in a position where a heated plastic compound in the form of a plastic composite is pressed through a fixed mould half to a space, formed between two mould halves, in view of compression moulding a plastic component,
- Figure 3 shows the injection-moulding machine when a movable mould half is displaced some way from a fixed mould half and the flat plastic component is removed from the movable mould half,
- 10 Figure 4 shows in perspective a matrix or a mould-cavity insert for insertion into the movable mould half, displaying a microstructure, the microstructure illustrated in simplified form in an enlarged partial view, not necessarily to scale,
- 15 Figure 5 shows a side view and in section an example of a method for manufacturing a matrix of previously known design,
- Figure 6 shows a side view and in section an example of a method for manufacturing a matrix in accordance with the invention,
- Figure 7 shows in perspective a first master divided into a number of identical
- 20 surface sections,
- Figure 8 shows in an enlarged view and in cross section, details of a matrix produced on the matrix illustrated in Figure 6,
- Figure 9 shows a partial section of a first embodiment of a matrix manufactured in accordance with the invention,
- 25 Figure 10 shows a partial section of a second embodiment of a matrix manufactured in accordance with the invention,
- Figure 11 shows the use of a mould cavity for manufacturing a matrix with a flat rear surface, and
- Figure 12 shows a sequence for manufacturing a matrix in accordance with the
- 30 invention.

### ***Description of preferred embodiment***

The present invention relates to a method for manufacturing a matrix 2 for a compression-moulding, embossing and/or injection-moulding machine 1.

- 35 This matrix or mould-cavity insert 2 is provided with a "negative" microstructure 2a on its surface, which microstructure 2a is reproducible in the injection-moulding machine 1 on a plastic component 3 produced from a plastic material, as a "positive" microstructure 3a.



The method for manufacturing a matrix 2 suitable as a mould-cavity insert will be described in more detail, primarily with reference to Figures 6, 7, 8 and 12.

For the sake of simplicity the following description assumes that only the movable mould half 1c is provided with a mould-cavity insert 2 having a micro-structure 2a. However, a person skilled in the art will realise that also the fixed mould half 1d could be provided with such a mould-cavity insert.

Figures 1-3 show schematically an injection-moulding machine 1 provided with an ejection rod 1a, a number (three) ejection pins 1b, a movable mould half 1c and a fixed mould half 1d.

A cavity 1e, shaped to conform with a flat plastic component 3 produced by injection moulding, is formed between the movable form half 1c and the fixed mould half 1d and displays an inlet 1f.

Figure 1 also illustrates the use of a "torpedo" or "pine apple" 1g, a cylinder wall 1h, a heating element 1i, an injection ram 1j and a feeding funnel 1k for granulate or powder 1m.

Figure 2 illustrates how a heated, fluid plastic compound or plastic material 4 surrounds the torpedo 1g and is pressed by a ram 1j through the inlet 1f to the cavity and into the cavity 1e, the mould halves 1c, 1d assuming the united position shown in Figure 1.

Figure 3 shows that the movable mould half 1c is moved a suitable distance from the mould half 1d and, with the aid of the ejector rod 1a and ejector pins 1b the flat plastic component 3 is released from the movable mould 1c and the plastic component 3 falls out of the mould half 1c.

Figure 4 shows, greatly simplified and in perspective, a matrix 2 shaped to a plate or disc and provided with an upwardly facing microstructure 2a assigned to the surface.

This microstructure is usually extremely complex. However, a very simplified embodiment is illustrated in Figure 4, enlarged but without any claim of being to scale.

For the sake of simplicity and clarity the following description will relate only to a first raised part 21, an intermediate recess 22 and a second raised part 23, all pertaining to the microstructure.

The matrix or mould-cavity insert 2 is thus provided with a negative micro-structure 2a on its surface.

The matrix 2 comprises a disc or plate with a flat lower surface 2b, usually a flat, machined surface 2b, and rests against a flat support surface 1c' in the movable mould half 1c.

It is important here that a flat surface 2b pertaining to the matrix is suitable for resting against a flat surface 1c' of the mould half 1c, or opposing curved sur-

faces, so that the matrix 2 can withstand the compressive forces that will be exerted during a manufacturing process, i.e. an injection-moulding process.

Figure 5 shows a cross section through a part of a known matrix 2, the cross section being taken through the raised portions 21 and 23, and the recess 22.

According to the known method, shown in Figure 5, said matrix 2 can be produced by a master 5, with a positive microstructured surface, being coated in known manner with a metal surface, by using only a plating process.

Metal layer upon metal layer is thus built up by the plating process, or equivalent process, on the microstructured surface section 5a of the master 5, so that a first metal layer will be able to cover even the lowest point of the microstructured surface part 5a.

Since such a plating process will provide a metal layer in which the upper surface is irregular due to the surface structure 5a, the plating process must continue to apply metal layer upon metal layer to a total thickness which, over the entire surface, will exceed a predetermined value or a plane designated 6 in Figure 5.

In practice, the previously known method now requires all the metal material placed above the surface 6, designed 6a, to be ground away in some way or another.

The plating process for layers as thick as is the case here takes an extremely long time, as well as grinding the excess metal material 6a down to the plane 6 also being time-consuming.

The present invention also uses a master 5 for manufacturing a matrix or mould-cavity insert 2. This master could in principle be manufactured in the same way as the master 5 in Figure 5.

The present invention comprises in the first place a method for the manufacture of a matrix or mould-cavity insert 2 provided with a microstructure on its surface, which microstructure is reproducible in a plastic material as an inverted microstructure in a machine used, said microstructure being manufactured by having a master with a microstructure on its surface coated with a layer, and in the second place to a matrix thus manufactured.

The invention is shown in Figure 6 using a first master 51 with a microstructure 51a, manufactured via a first method or a matrix 51' manufactured from such a master, and a second master 52 with a microstructure 52a produced via a second method or a matrix 52' manufactured from such a master, these being combined to form a hybrid matrix.

A hybrid matrix is a matrix that has a microstructured surface emanating from two or more masters or matrices produced from two or more manufacturing methods, each appropriate for a chosen microstructure.

Said first matrix 51 and second matrix 52, or matrix parts 51', 52', can now be applied, with their microstructured surfaces 51a, 52a, against a support 60.

Said first and second matrix parts 51', 52' can now be coated with a first layer, here designated a support layer 7.

Said layer 7 shall then be covered by a thicker layer, a carrier 8.

Said first and second matrix parts 51', 52', together with said first layer 7 and said carrier 8 are now removed from the support 60 as a matrix-related unit.

Should the surfaces, 71, 72, 73 and 74 thus exposed not be suitable for direct application in a unit for forming plastic components, it is suggested that the surfaces 71, 72, 73 and 74 in Figure 6 be provided with a wear layer 7', or the surfaces 71, 72, 73 and 74 may form surfaces for manufacturing a new matrix.

This method is associated with the method shown and described in Swedish patent application 99 03232-8, filed 10 September 1999 under the title "A method for the manufacture of a matrix and a matrix manufactured according to said method".

Figure 7 illustrates that a first master 51 can be manufactured in a first manufacturing process, with a number of identical surface sections 51:1, 51:2, whereupon a matrix manufactured from this master will also display a corresponding number of identical surface sections, two of which have been designated 51':1, 51':2, and each of these can be separated in order to form matrix sections, such as a first matrix section 51':1 in Figure 4.

Said second master can also be manufactured having a number of identical surface sections, and a matrix manufactured for this master can also display a corresponding number of identical surface sections, and each of these 52':1 can be separated to form a second matrix section. This is not shown in more detail but is obvious to one skilled in the art.

One or more first matrix sections, one or more second matrix sections, one or more additional matrix sections are applied with their microstructured surfaces against said support 60 in an order and an orientation that will conform with the desired result on a matrix and/or a plastic material produced.

A sheet of nickel is chosen as support 60, said nickel sheet preferably consisting of a flat sheet with a polished surface 60a, like the surface of a mirror.

Said first master or a first matrix section and said second master or a second matrix section, etc., are pressed against the support 60, at least while they are being covered by a first layer 7 by means not shown in detail.

The first matrix 51 or matrix section 51:1 has been provided with a first type of one among several selectable microstructures.

The second matrix 52 or matrix section 52:1 has been provided with a second type of one among several selectable microstructures, and so on.

5 In accordance with the present invention these microstructured surfaces 51a, 52a may be covered with a thick wear layer.

Figure 6 shows, somewhat exaggerated, that parts of a machined matrix material, such as the surfaces 71, 72, 51a and 52a, form islands in an applied layer 7.

10 There is nothing to prevent a thin wear layer 7' (see Figure 8) from being applied on the surfaces 71, 72, 51a and 52a, as well as the layer 7, after the matrix has been removed from the support 60.

This thin wear layer 7' shall display an outer first wear surface 7a. (By "wear surface" 7a is here meant a surface against which the hot liquid plastic material shall be pressed and against which wear surface the plastic component 3 shall be moulded before being fed out of the mould halves 1c, 1d.)

This wear layer 7', which forms the first wear surface 7a, shall be so thin - say up to 2  $\mu\text{m}$ , that it will display a negative outer microstructure 2a corresponding directly to the positive microstructure 5a of the master 5.

20 Persons skilled in the art are well aware that methods and procedures used here result in different thicknesses for the layer 7 and 7', and a thickness and a method must be selected that are suitable for the chosen application.

This first wear layer 7 and 7' could consist of a plastic composite or other hard material. However, the following description is aimed at illustrating this thin first metal layer or wear layer 7, 7' as a metal layer 7'.

This metal layer 7, 7' can be applied using known technology, such as sputtering or vaporisation.

30 In accordance with the invention the uppermost surface 7b of said thin metal layer 7 in Figure 6 will display microstructured parts 51, 52 corresponding substantially to the irregularities 7b.

In accordance with the invention, said irregularities 7b shall be filled in a second step with a chosen plastic composite 8'. The plastic compound for this plastic composite 8' shall be hot and thinly fluid so that it will be able to cover all the recesses 7c and so that the plastic composite can form a smooth upper surface 8a.

Figure 6 illustrates an embodiment in which a plastic composite 8' is poured in in order to form a carrier 8 so that a small amount 8a' will be situated above the plane 6 and an imagined flat surface 8a, and the raised plastic material 8a' can easily be removed by a mechanical planing process.

The matrix 2, in the form of a carrier 8 and a thin first wear surface 7a, is applied in the movable mould half 1c, with the surface 2b (6) in contact with the surface 1c'.

The invention also assumes that pouring in the plastic composite 8' to form a carrier 8 can very well be performed under pressure in a mould cavity in such a way that machining of the rear side will not be necessary.

This third step in the manufacturing process is described in more detail with reference to Figure 11.

Many opportunities for adaptation are offered by advocating the use of a plastic composite 8' and a carrier 8 formed therefrom.

It is well known that various polymer materials and mixtures thereof mixed with different filler materials and mixtures thereof give different properties, and also that the curing process and curing time chosen affect the final properties of the plastic composite.

These known directives offer a number of different possibilities applied on a matrix in accordance with the invention.

It is thus possible to select a plastic composite 8' from a polymer material mixed with a filler, such as a quartz or metal-filled epoxy or silicon polymer.

The present invention also proposes that the plastic composite 8' and a carrier 8 formed therefrom may be chosen with a coefficient of linear expansion and/or a heat transfer capability and/or a thermal capacitive capability suitable for a chosen process and/or nature of the machine used.

The plastic composite 8' may be cured by the supply of heat and/or illumination by means of UV light. These curing possibilities can be used with advantage so that the required degree of curing and rigidity of the plastic composite can be adjusted.

There is nothing to prevent the plastic composite being selected from two-component types.

Figures 9 and 10 illustrate that a selected plastic composite 8' for forming a carrier 8, placed against the hard metal layer 7 serving as a first wear surface 7a, is selected with a suitably low heat transfer capability and/or a suitably high thermal capacitive capability so that this plastic composite 8' and carrier 8 will be able to serve as thermal insulation against the mould half 1c and thus keep the compression-moulded plastic compound material in the machine hot for the time required for producing the microstructured pattern 3a in the plastic component 3.

In many cases, to ensure exact microstructure-related transfer, the heat and temperature of a compression-moulded plastic material must be retained in the plastic material without being passed over too quickly to the mould half 1c.

Also in accordance with the invention said matrix 2, as shown in Figures 9 and 10, is coated with or applied on a second wear layer 9 with a second wear surface 9a. This layer 9 is coated on the surface 8a of the carrier 8 facing away from the metal layer 7, and may consist of a durable layer and/or a heat-insulating layer.

The properties of this second wear layer 9 shall be to display a wear surface 9a with low friction against the surface 1c' of the mould half 1c, and high wear resistance, since the pressure between matrix 2 and mould half 1c is considerable during the moulding process and thermal stresses tend to displace the matrix 2 in relation to the mould half 1c.

The second wear layer 9 may here advantageously consist of titanium nitride or DLC (Diamond-Like-Carbon).

For certain applications there is nothing to prevent a chosen material for the second wear layer 9 also constituting the material for the thin first wear layer 7a, with a carrier 8 made of plastic placed between them.

The thin metal layer 7 may be applied by means of a sputtering process and/or a vaporising process or, alternatively, a plating process.

Figure 10 shows an alternative embodiment with a wear-resistant second wear layer 9, a carrier 8 formed from a plastic composite 8', and a thin first wear layer in the form of a metal layer 7, where a recess 22 having been added to the dimension shown in Figure 4 and an adjacent recess 24 having been chosen considerably deeper than the recess 22 without, however, departing from the significant features of the invention.

Furthermore, a carrier 8 with carrier surface 8b for the thin first wear layer 7 and/or this layer 7 may consist of a plastic composite 8' with a coefficient of linear expansion and/or a heat transfer capability and/or a thermal capacitive capability suitable for a chosen process and/or to the relevant embodiment of the injection-moulding machine used.

The carrier 8 may also consist of a plastic composite that can be assigned different degrees of curing ability by supplying different degrees of heat and/or illumination by means of UV light.

The carrier 8 may also consist of a material with low heat transfer capability and high thermal insulation and/or thermal capacitive capability.

There is nothing to prevent the carrier 8 being reinforced using means known per se. The carrier 8 can thus be reinforced with an additional wear-resistant layer 9 on its surface facing away from the metal surface 7.

Although the invention is described in the above embodiment by way of example in that a thin wear layer 7 is supported by a thicker plastic layer or carrier

8, it may be suitable in certain applications for these two wear layers to consist of the same plastic material.

There is nothing to prevent allowing the wear layer 7 to harden first, preferably at a high degree of curing, and the supporting plastic layer or carrier 8 later, at a lower degree of curing.

Figure 11 shows the possibility of applying the plastic composite 8' to a mould cavity 90 in the form of a mould 91, by means of an overpressure from a ram 92 so that the surface 8a of the carrier 8 becomes flat, conforming with the surface section 91a of the mould 91.

This flat surface 8a can now be applied directly against the support surface 1c' of the mould half 1c.

As regards the thickness of the layer 7, a basic rule is that it shall be thick enough not to collapse or crack for a chosen number of casting cycles. In practice this means a thickness of 1-5  $\mu\text{m}$ .

More generally, it is probably advisable for the thickness to be chosen between 1 and 50  $\mu\text{m}$ , preferably less than 20  $\mu\text{m}$ .

However, for certain applications layers as thin as about 0.1  $\mu\text{m}$  can be accepted, depending partly on the choice of material in the carrier 8.

The thickness of the wear layer 9 may be chosen between 1 and 50  $\mu\text{m}$ , preferably less than 20  $\mu\text{m}$ .

The microstructure 2a may vary in depth between 0.1 and 1000  $\mu\text{m}$ , preferably over 100  $\mu\text{m}$ .

Figure 12 shows an alternative embodiment of the application of the invention.

A first matrix 121 with a fine microstructure 121a is manufactured in a first master (not shown), and a second matrix 122 with a coarse micro-structure 122a is manufactured in a second master.

A surface section 121b is punched out of the matrix 121 and removed.

A corresponding surface section 122b is punched out of the matrix 122 and placed where the surface section 121b was previously.

A matrix 123 has thus been created, in which large surface areas have a fine microstructure, with an island of a coarse microstructure.

The method shown in Figure 12 involves the following process steps:

1. Manufacturing a first original with a fine microstructure, for instance, by means of lithography, with the aid of a laser, etching processes, precipitation, mechanical micromachining.
2. Manufacturing a second original with a coarse microstructure, for instance.
3. Manufacturing a matrix (121, 122) from the first and the second original.

4. Manufacturing a matrix original (123) containing parts of the first and the second matrices.

It is here suitable to reinforce the matrix original with a carrier or form a matrix from the matrix original.

- 5 The invention is naturally not limited to the embodiment described above by way of example, but may be modified within the scope of the inventive concept as defined in the appended claims.
-



## CLAIMS

1. A method for the manufacture of a matrix provided with a microstructure on its surface, which microstructure is reproducible in a plastic material as an inverted microstructure in a machine used, said microstructure being producible by having a master with a microstructure on its surface coated with a layer, **characterized** in that
  - a) a first master, with a first chosen microstructure, is produced via a first method,
  - b) a second master, with a second chosen microstructure, is produced via a second method,
  - c) said first and second masters or matrices produced therefrom are applied with their microstructured surfaces adjacent,
  - d) said first and second masters or equivalent are covered by a first layer pertaining to the matrix,
  - e) said layer is covered by a thicker layer, a carrier, and
  - f) said first and second first layer pertaining to the matrix and said carrier are removed from said masters or the equivalent, as a matrix-related unit.
2. A method as claimed in claim 1, **characterized** in that said first master is produced having a number of similar or dissimilar surface sections, and in that each of these, transferred to a matrix, is removed to form a first matrix section.
3. A method as claimed in claim 1, **characterized** in that said second master is produced having a number of similar or dissimilar surface sections, and in that each of these, transferred to a matrix, is removed to form a second matrix section.
4. A method as claimed in claims 1, 2 or 3, **characterized** in that one or more first matrix sections and one or more second matrix sections are applied with their microstructured surfaces against a support.
5. A method as claimed in claim 1, **characterized** in that a sheet of nickel is chosen as the support.
6. A method as claimed in claim 5, **characterized** in that said sheet consists of a flat sheet with polished surface, a mirror surface.
7. A method as claimed in claim 1, **characterized** in that said first matrix or a first matrix section, and said second matrix or a second matrix section, are

pressed against a support at least while they are being covered by a first wear layer.

8. A method as claimed in claim 1, **characterized** in that the first matrix or  
5 matrix section has been provided with a first type of one amongst several selectable microstructures.
9. A method as claimed in claim 1, **characterized** in that the second matrix  
10 or matrix section has been provided with a second type of one amongst several selectable microstructures.
10. A method as claimed in claim 1, **characterized** in that a carrier is formed  
by filling a mould cavity with a plastic composite.
- 15 11. A method as claimed in claim 1 and claim 10, **characterized** in that the plastic composite is selected from a mixture of a polymer material and a filler material, such as quartz or metal-filled epoxy or silicon polymer.
- 20 12. A method as claimed in claim 1, **characterized** in that the plastic composite and the carrier formed are chosen with a coefficient of linear expansion and/or a heat transfer capability and/or a thermal capacitive capability suitable for a chosen process in the injection-moulding machine.
- 25 13. A method as claimed in claim 1 or claim 10, **characterized** in that the plastic composite is cured by the supply of heat and/or by being irradiated by UV light.
- 30 14. A method as claimed in claim 1 or claim 11, **characterized** in that the plastic composite is selected from two-component types.
15. A method as claimed in claim 1 or claim 10, **characterized** in that a plastic composite, under a hard first wear layer, is selected with a suitable heat transfer and/or thermal capacitive capability for keeping the plastic compound pressed out in the machine hot.
- 35 16. A method as claimed in claim 1 or claim 10, **characterized** in that said matrix is coated with a second wear layer on the surface facing away from the surface of the first wear layer.

17. A method as claimed in claim 1, claim 10 or claim 16, **characterized** in that said first wear layer and/or said second wear layer consist of titanium nitride or DLC (Diamond-Like-Carbon).

18. A method as claimed in claim 1 or claim 10, **characterized** in that said thin first wear layer is in the form of a metal layer and is applied by means of a sputtering process and/or a vaporising process or, alternatively, a plating process.

19. A method as claimed in claim 1, claim 10 or claim 18, **characterized** in that the first wear layer and/or metal layer is selected having a thickness adapted to stipulated requirements.

20. A method as claimed in claim 1, or claim 10, **characterized** in that the surface structure of the plastic composite on the surface facing away from the wear and/or metal layer, is machined flat.

21. A matrix provided with a microstructure on its surface, which microstructure is reproducible in a plastic material as an inverted microstructure in a machine used, said microstructure being manufactured by having a master with a microstructure on its surface coated with a layer, **characterized** in that said microstructure consists of microstructured surfaces of a first and a second master, or matrices produced therefrom, which surfaces are oriented adjacent each other, in that said first and second masters or equivalent are covered by a first layer pertaining to the matrix, and in that said layer is covered by a thicker layer, a carrier.

22. A matrix as claimed in claim 21, **characterized** in that said first master-related surface sections pertaining to the matrix are produced having a number of similar or dissimilar surface sections, and in that each of these, transferred to a matrix, is removed to form a first matrix section.

23. A matrix as claimed in claim 21, **characterized** in that said second master-related surface sections pertaining to the matrix are produced having a number of similar or dissimilar surface sections, and in that each of these, transferred to a matrix, is removed to form a second matrix section.

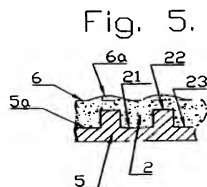
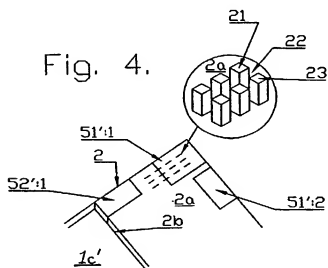
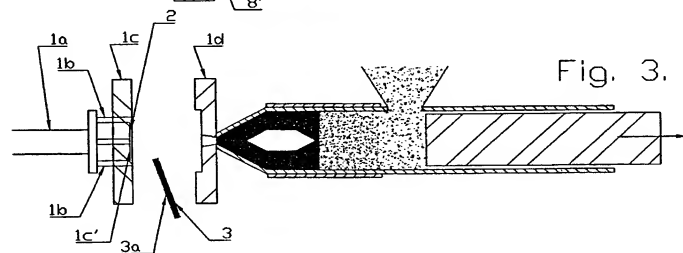
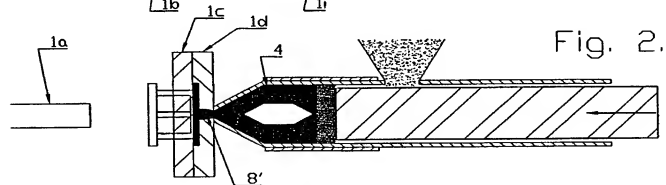
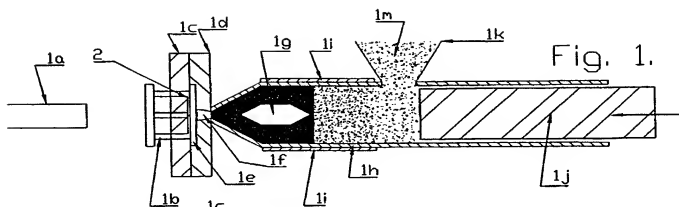
24. A matrix as claimed in claim 21, claim 22 or claim 23, **characterized** in that one or more first matrix sections and one or more second matrix sections are applied with their microstructured surfaces supported against a support.

25. A matrix as claimed in claim 21, **characterized** in that the first matrix or matrix section has been provided with a first type of one amongst several selectable microstructures.

5 26. A matrix as claimed in claim 21, **characterized** in that the second matrix or matrix section has been provided with a second type of one amongst several selectable microstructures.

---

1/3



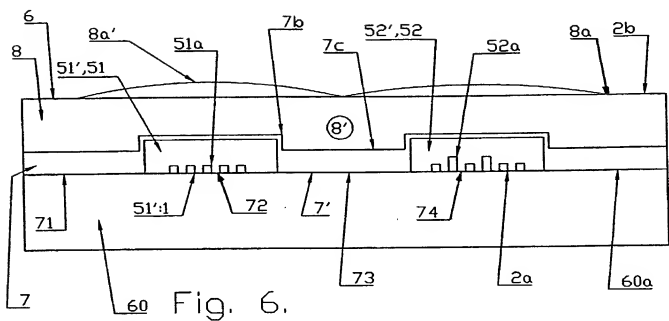


Fig. 6.

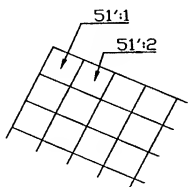


Fig. 7.

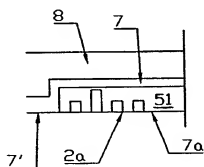


Fig. 8.

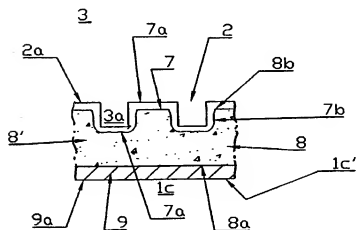


Fig. 9.

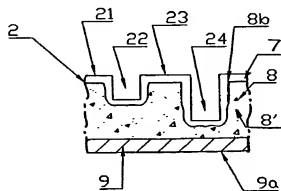


Fig. 10.

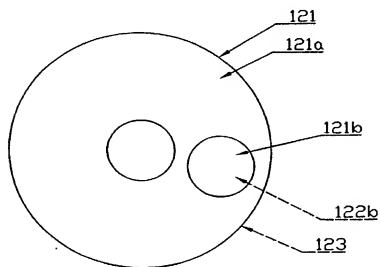
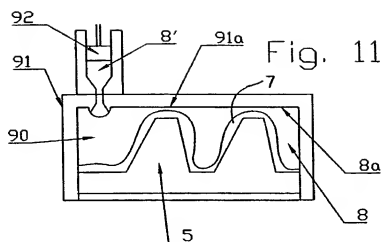
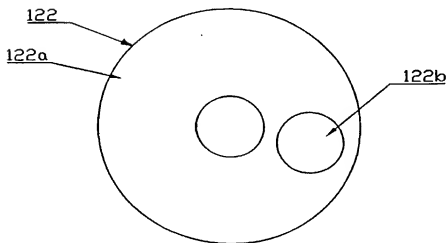


Fig. 12.



**BIRCH, STEWART, KOLASCH & BIRCH, LLP**

P.O. Box 747 • Falls Church, Virginia 22040-0747  
 Telephone: (703) 205-8000 • Facsimile: (703) 205-8050

PLEASE NOTE:  
 YOU MUST  
 COMPLETE THE  
 FOLLOWING

# **COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT AND DESIGN APPLICATIONS**

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated next to my name, that I verily believe that I am the original, first and sole inventor (if only one inventor is named below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Insert Title: A METHOD FOR THE MANUFACTURING OF A MATRIX AND A MATRIX MANUFACTURED ACCORDING TO SAID METHOD

Fill in Appropriate  
 Information -  
 For Use Without  
 Specification  
 Attached:

the specification of which is attached hereto If not attached hereto,

the specification was filed on \_\_\_\_\_ as  
 United States Application Number \_\_\_\_\_  
 and amended on \_\_\_\_\_ (if applicable) and/or  
 the specification was filed on September 11, 2000 as PCT  
 International Application Number PCT/SE00/01755 ; and was  
 amended on \_\_\_\_\_ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I do not know and do not believe the same was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representative or assigns more than twelve months (six months for designs) prior to this application, and that no application for patent or inventor's certificate on this invention has been filed in any country foreign to the United States of America prior to this application by me or my legal representatives or assigns, except as follows.

I hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

**Prior Foreign Application(s)****Priority Claimed**

Insert Priority  
 Information:  
 (if appropriate)

9903255-9  
 (Number)

Sweden  
 (Country)

September 13, 1999  
 (Month/Day/Year Filed)

☒ Yes ☐ No

(Number)

(Country)

(Month/Day/Year Filed)

☐ Yes ☐ No

(Number)

(Country)

(Month/Day/Year Filed)

☐ Yes ☐ No

(Number)

(Country)

(Month/Day/Year Filed)

☐ Yes ☐ No

I hereby claim the benefit under Title 35, United States Code, §119(c) of any United States provisional applications(s) listed below.

Insert Provisional  
 Application(s):  
 (if any)

(Application Number)

(Filing Date)

(Application Number)

(Filing Date)

All Foreign Applications, if any, for any Patent or Inventor's Certificate Filed More than 12 Months (6 Months for Designs) Prior to the Filing Date of This Application:

Country

Application Number

Date of Filing (Month/Day/Year)

Insert Requested  
 Information:  
 (if appropriate)

(Application Number)

I hereby claim the benefit under Title 35, United States Code, §120 of any United States and/or PCT application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States and/or PCT application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to the patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

Insert Prior U.S.  
 Application(s):  
 (if any)

(Application Number)

(Filing Date)

(Status - patented, pending, abandoned)

(Application Number)

(Filing Date)

(Status - patented, pending, abandoned)



I hereby appoint the practitioners at CUSTOMER NO. 2292 as my attorneys or agents to prosecute this application and/or an international application based on this application and to transact all business in the United States Patent and Trademark Office connected therewith and in connection with the resulting patent based on instructions received from the entity who first sent the application papers to the practitioners, unless the inventor(s) or assignee provides said practitioners with a written notice to the contrary:

Send Correspondence to:

**BIRCH, STEWART, KOLASCH & BIRCH, LLP** or CUSTOMER NO. 2292

P.O. Box 747 • Falls Church, Virginia 22040-0747

Telephone: (703) 205-8000 • Facsimile: (703) 205-8050

PLEASE NOTE:  
YOU MUST  
COMPLETE  
THE  
FOLLOWING:  
↓

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of First  
or Sole Inventor:  
Insert Name of  
Inventor  
Insert Date This  
Document is Signed

Insert Residence  
Insert Citizenship

Insert Post Office  
Address

Full Name of Second  
Inventor, if any:  
see above

Full Name of Third  
Inventor, if any:  
see above

Full Name of Fourth  
Inventor, if any:  
see above

Full Name of Fifth  
Inventor, if any:  
see above

Full Name of Sixth  
Inventor, if any:  
see above

GIVEN NAME/FAMILY NAME Ove OHMAN	INVENTOR'S SIGNATURE <i>Ove Ohman</i>	DATE* 08 FEB. 2002
Residence (City, State & Country) Uppsala SWEDEN	CITIZENSHIP Swedish SEX	
MAILING ADDRESS (Complete Street Address including City, State & Country) Asplunda, Uppsala-Nas, S-755 91 Uppsala SWEDEN		
GIVEN NAME/FAMILY NAME Olov LARSSON	INVENTOR'S SIGNATURE <i>Olov Larsson</i>	DATE* 08 FEB. 2002
Residence (City, State & Country) Stockholm SWEDEN	CITIZENSHIP Swedish SEX	
MAILING ADDRESS (Complete Street Address including City, State & Country) Ruddamsvägen 35 A, S-114 21 Stockholm SWEDEN		
GIVEN NAME/FAMILY NAME	INVENTOR'S SIGNATURE	DATE*
Residence (City, State & Country)	CITIZENSHIP	
MAILING ADDRESS (Complete Street Address including City, State & Country)		
GIVEN NAME/FAMILY NAME	INVENTOR'S SIGNATURE	DATE*
Residence (City, State & Country)	CITIZENSHIP	
MAILING ADDRESS (Complete Street Address including City, State & Country)		
GIVEN NAME/FAMILY NAME	INVENTOR'S SIGNATURE	DATE*
Residence (City, State & Country)	CITIZENSHIP	
MAILING ADDRESS (Complete Street Address including City, State & Country)		
GIVEN NAME/FAMILY NAME	INVENTOR'S SIGNATURE	DATE*
Residence (City, State & Country)	CITIZENSHIP	
MAILING ADDRESS (Complete Street Address including City, State & Country)		